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Abstract

This paper considers the *use* of genetic algorithms (GAs) for the solution of problems that are both average-sense misleading (deceptive) and massively multimodal. An archetypical multimodal-deceptive problem, here called a bipolar deceptive problem, is defined and two

generalized constructions of such problems are reviewed, one *using* reflected trap functions and one *using* low-order Walsh coefficients; sufficient conditions for bipolar deception are also reviewed. The Walsh construction is then *used* to form a 30-bit, order-six bipolar-deceptive function by concatenating five, six-bit bipolar functions. This test function, with over five million local optima and 32 global optima, poses a difficult challenge to simple and niched GAs alike. Nonetheless, simulations show that a simple GA can reliably find one of the 32 global optima if appropriate signal-to-noise-ratio population sizing is adopted. Simulations also demonstrate that a niched GA can reliably and simultaneously find all 32 global solutions if the population is roughly sized for the expected niche distribution and if the function is appropriately scaled to emphasize global solutions at the expense of suboptimal ones. These results immediately recommend the application of niched GAs *using* appropriate population sizing and scaling. They also suggest a number of avenues for generalizing the notion of deception. 1*Genetic Algorithms*

- by David E. Goldberg, David E. Goldberg, Kalyanmoy Deb, Kalyanmoy Deb, Jeffrey Horn, Jeffrey Horn — 1989 — in Search, Optimization, and Machine Learning
- … solutions. Not only do these results lend immediate support to the *use* of niched GAs to solve highly multimodal problems in practice, but the study also gives some hints how to generalize the notion of deception to characterize these and other types of difficult problems. 2 Imagining a massively multimodal and deceptive function Rik Belew once jokingly remarked to the first *author* that it requires…
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Abstract

This document is an electronic version of Communicating Sequential Processes, first published in 1985 by Prentice Hall International. It may be copied, printed, and distributed free of charge. However, such copying, printing, or distribution may not: – be carried out for commercial gain; or*Communicating Sequential Processes*

- by C. A. R. Hoare, C. A. R. Hoare — 1985 — Communications of the ACM
- … and shown to be *useful*, and subject to elegant laws. Chapter 6 describes how to structure and implement a system in which a limited number of physical resources such as discs and line printers can be shared among a greater number of processes, whose resource requirements vary with time. Each resource is represented as a single process. On each occasion that a resource is required by a *user* process, a new…
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Abstract

Abstract: Many systems have been developed for constructing decision trees from collections of examples. Although the decision trees generated by these methods are accurate and efficient, they often suffer the disadvantage of excessive complexity that can render them incomprehensible to experts. It is questionable whether opaque structures of this kind can be described as knowledge, no matter how well they function. This paper discusses techniques for simplifying decision trees without compromising their accuracy. Four methods are described, illustrated, and compared on a test-bed of decision trees from a variety of domains.*Induction of Decision Trees*

- by J. R. Quinlan — 1986 — Machine Learning
- … of error rate and number of leaves. Secondly, it seems anomalous that the cost-complexity model *used* to generate the sequence of subtrees is abandoned when the best tree is selected. Finally, the procedure requires a test set distinct from the original training set; the *authors* show, however, that a cross-validation scheme can be employed to generate these estimates at the time the original tree…
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Abstract

In this paper we present a new data structure for representing Boolean functions and an associated set of manipulation algorithms. Functions are represented by directed, acyclic graphs in a manner similar to the representations introduced by Lee [1] and Akers [2], but with further restrictions on the ordering of decision variables in the graph. Although a function requires, in the worst case, a graph of size exponential in the number of arguments, many of the functions encountered in typical applications have a more reasonable representation. Our algorithms have time complexity proportional to the sizes of the graphs being operated on, and hence are quite efficient as long as the graphs do not grow too large. We present experimental results from applying these algorithms to problems in logic design verification that demonstrate the practicality of our approach. Index Terms: Boolean functions, symbolic manipulation, binary decision diagrams, logic design verification 1.*Graph-based algorithms for Boolean function manipulation*

- by Randal E. Bryant — 1986 — IEEE Transactions on Computers
- … and at Carnegie-Mellon University by the Defense Advanced Research Projects Agency ARPA Order Number 3597. A preliminary version of this paper was presented under the title "Symbolic Manipulation of Boolean Functions *Using* a Graphical Representation" at the 22nd Design Automation Conference, Las Vegas, NV, June 1985. 2 Update: This paper was originally published in IEEE Transactions on Computers, C-35-8, pp…

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Abstract

In this article we briefly review the central constructs in combinatorial opti-mization and in statistical mechanics and then develop the similarities between the two fields. We show how the Metropolis algorithm for approximate numerical simulation of the behavior of a manybody system at a finite temperature provides a natural tool for bringing the techniques of statistical mechanics to bear on optimization. We have applied this point of view to a number of problems arising in optimal design of computers. Applications to partitioning, component placement, and wiring of electronic systems are de-scribed in this article. In each context, we introduce the problem and discuss the improvements available from optimi-zation. Of classic optimization problems, the traveling salesman problem has received the most intensive study. To test the power of simulated annealing, we *used* the algorithm on traveling salesman problems with as many as several thou-sand cities. This work is described in a final section, followed by our conclu-sions.*Optimization by simulated annealing*

- by S. Kirkpatrick, C. D. Gelatt, M. P. Vecchi — 1983 — Science
- … and discuss the improvements available from optimi- zation. Of classic optimization problems, the traveling salesman problem has received the most intensive study. To test the power of simulated annealing. we *used* the algorithm on traveling salesman problems with as many as several thou- sand cities. This work is described in a final section, followed by our conclu- sions. Combinatorial Optimization…
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Abstract

A fundamental problem that confronts peer-to-peer applications is to efficiently locate the node that stores a particular data item. This paper presents Chord, a distributed lookup protocol that addresses this problem. Chord provides support for just one operation: given a key, it maps the key onto a node. Data location can be easily implemented on top of Chord by associating a key with each data item, and storing the key/data item pair at the node to which the key maps. Chord adapts efficiently as nodes join and leave the system, and can answer queries even if the system is continuously changing. Results from theoretical analysis, simulations, and experiments show that Chord is scalable, with communication cost and the state maintained by each node scaling

logarithmically with the number of Chord nodes. 1.*Chord: A Scalable Peer-to-Peer Lookup Service for Internet Applications*

- by Ion Stoica, Robert Morris, David Karger, M. Frans Kaashoek, Hari Balakrishnan Ý — 2001
- … notifies the application of changes in the set of keys that the node is responsible for. This allows the application software to, for example, move corresponding values to their new homes when a new node joins. The application *using* Chord is responsible for providing any desired authentication, caching, replication, and *user*-friendly naming of data. Chord's flat key space eases the implementation…
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Abstract

An encryption method is presented with the novel property that publicly revealing an encryption key does not thereby reveal the corresponding decryption key. This has two important consequences: 1. Couriers or other secure means are not needed to transmit keys, since a message can be enciphered *using* an encryption key publicly revealed by the intended recipient. Only he can decipher the message, since only he knows the corresponding decryption key. 2. A message can be "signed " *using* a privately held decryption key. Anyone can verify this signature *using* the corresponding publicly revealed encryption key. Signatures cannot be forged, and a signer cannot later deny the validity of his signature. This has obvious applications in "electronic mail " and "electronic funds transfer " systems. A message is encrypted by representing it as a number M, raising M to a publicly specified power e, and then taking the remainder when the result is divided by the publicly specified product, n, of two large secret prime numbers p and q. Decryption is similar; only a different, secret, power d is *used*, where e \Delta d j 1 (mod (p \Gamma 1) \Delta (q \Gamma 1)). The security of the system rests in part on*A method for obtaining digital signatures and public-key cryptosystems*

- by R. L. Rivest, A. Shamir, L. Adleman — 1978 — Communications of the ACM
- … grant MCS76-14294, and the Office of Naval Research grant number N00014-67-A-0204-0063. *Note. This paper was submitted prior to the time that Rivest became editor of the department, and editorial consideration was completed under the former editor, G.K. Manchester. *Author*'s Address: Laboratory for Computer Science, Massachusetts Institute of Technology, Cambridge, MA 02139 *E-mail* addresses: rivest…
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Abstract

of a delay-bandwidth product) that were full much of the time; this would significantly increase the average delay in the network. Therefore, with increasingly high-speed ways for congestion avoidance in packet-switched net- networks, it is increasingly important to have mechanisms works. The gateway detects incipient congestion by com- that keep throughput high but average queue sizes low. puting the average queue size. The gateway could notify In the absence of explicit feedback from the gateway, connections of congestion either by dropping packets ar- there are a number of mechanisms that have been proriving at the gateway or by setting a bit in packet headers. posed for transport-layer protocols to maintain high through-When the average queue size exceeds a preset threshold, put and low delay in the network. Some of these proposed the gateway drops or marks each arriving packet with a mechanisms are designed to work with current gateways certain probability, where the exact probability is a func- [15, 23, 31, 33, 34], while other mechanisms are coution of the average queue size. pled with gateway scheduling algorithms that require per-RED gateways keep the average queue size low while connection state in the gateway [20, 22]. In the absence of allowing occasional bursts of packets in the queue. During explicit feedback from the gateway, transport-layer proto-*Random early detection gateways for congestion avoidance*

- by Sally Floyd, Van Jacobson — 1993 — IEEE/ACM Transactions on Networking
- … the robustness of RED gateways for a range tion's response to congestion is less severe, it is also less of traffic and for a range of parameter values. Simula- 2 tions in Section 9 demonstrate, among other things, the RED gateway's lack of bias against bursty traffic. Section 10 describes how RED gateways can be *used* to identify those *users* that are *using* a large fraction of the bandwidth through a congested…
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Abstract

In order to handle spatial data efficiently, as required in computer aided design and geo-data applications, a database system needs an mdex mechanism that ti help it retrieve data items quickly accordmg to their spatial locations However, traditional mdexmg methods are not well suited to data oblects of non-zero size located m multi-dimensional spaces In this paper we describe a dynarmc mdex structure called an R-tree winch meets this need, and give algorithms for searching and updatmg it. We present the results of a series of tests which indicate that the structure performs well, and conclude that it is *useful* for current database systems m spatial applications 1. Intxoduction Spatial data oblects often cover areas m multi-dimensional spaces and are not well represented by pomt locations For example, map objects like counties, census tracts etc occupy regions of non-zero size m two dnnenslons A common operation on spatial data

1s a search for all oblects m an area, for example to find all counties that have land mthm 20 nnles of a particular pomt Tl~s kmd of spatial search occurs frequently m computer tided design (CAD) and geo-data applications, and therefore it 1s unportant to be able to retneve oblects efficiently according to their spatial loca-tion 'llus research was sponsored by National*R-trees: A Dynamic Index Structure for Spatial Searching*

- by Antomn Guttman — 1984 — In B. Yormark (Ed.), SIGMOD'84, Proceedings of Annual Meeting
- … suited to data oblects of non-zero size located m multi- dimensional spaces In this paper we describe a dynarmc mdex structure called an R-tree winch meets this need, and give algorithms for searching and updatmg it. We present the results of a series of tests which indicate that the structure performs well, and conclude that it is *useful* for current database systems m spatial applications 1…
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Abstract

In this work we study complexity classes in monotone computation. Our main contributions are the following: ffl A consistent framework for monotone computation, including monotone analogues of many standard computational models. We define monotone simulations, and show that many (but not all) of the familiar simulations from general complexity theory are in fact monotone. ffl The search for provably non-monotone simulations as a research goal in monotone complexity. Our new example is the following: the simulation techniques of Immerman and Szelepcs'enyi are provably non-monotone, since we can separate mNL*Computational Complexity*

- by Michelangelo Grigni, Michael Sipser — 1994 — In Proceedings of the 14th Annual ACM Symposium on Theory of Computing
- …Structure in Monotone Complexity by Michelangelo Grigni B.S. Computer Science and Mathematics Duke University (1986) Submitted to the Department of Mathematics in partial fulfillment of the requirements for the degree of Doctor of Philosophy at the MASSACHUSETTS INSTITUTE OF TECHNOLOGY June 1991 c fl Massachusetts Institute of Technology 1991 Signature of *Author*…
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